1120. Elements of Design

1120.1. General

The basic geometric elements of design are described in the *AASHTO A Policy on the Geometric Design of Highways and Streets 2001.* Recommendations and amendments to some of the design elements described by AASHTO may occur in the *Alaska Preconstruction Manual.* Use the design criteria set forth in the *AASHTO A Policy on the Geometric Design of Highways and Streets 2001,* as appropriate to the scope of any given project. The discussions, references and examples in this Section 1120 of the manual are preferential. Departures from Section 1120 preferential references for the design of highways and streets, other than interstate, do not require a design waiver, however, they should be supported by adequate documentation.

1120.2. Interstate

1120.2.1 General

Interstate design criteria are essentially the same as for any limited-access, high-speed arterial. Some exceptions apply to Alaskan Rural Interstate roadways by agreement with the FHWA. This section describes these exceptions.

1120.2.2 Design Speed

Interstate rural design speed for level terrain is 70 mph, for rolling terrain is 60 mph, and for mountainous terrain is 50 mph. The minimum design speed for urban interstate is 60 mph.

1120.2.3 Roadway Width

Interstate criteria generally require a minimum four-lane divided facility. In Alaska, unless the DHV exceeds the capacity of a two-lane, two-way facility, a two-lane is acceptable provided the width requirements for arterials provided in the AASHTO publication *A Policy on the Geometric Design of Highways and Streets 2001* are followed and the interstate surface is no less than 36 feet from outside shoulder to outside shoulder.

1120.2.4 Access Control

Interstate roadways by definition are major arterials and continuous control of legal access is highly desirable. In urban and suburban areas, legal access to interstate roadways should only be via a public roadway; there should be no private access points. In rural areas, public roadways are desirable access points. However, private access points may be required where the route traverses major private land holdings.

1120.3. Bridges

1120.3.1 General

Use the latest edition (with interims) of the *AASHTO Bridge Design Specifications* in the design of all bridges. Refer to 1160.1.3 for bridges on 3R projects.

1120.3.2 Design Loads

The design live load for all interstate bridges shall be HS-25. HS-25 shall also be the live load for major hauling routes, for routes accessing major shipping points, and for access routes to identified resource areas.

All designs shall include 26 psf for future surfacing dead load.

1120.3.3 Seismic Design

a. General: All new structures must follow the requirements as stated in 1 above. All bridge retrofit projects (except 3R) must follow the latest *FHWA Seismic Retrofitting Manual for Highway Bridges.*

b. Seismic Sensitivity: The state materials engineer will provide the seismic level of activity for a given site.

c. Seismic Resistance Standards: Simply supported multiple span structures require the ends of the superstructure to be tied together and to the substructure. Do not use skew angles for bridges greater than 30 degrees unless approved by the chief bridge engineer, and do not use steel rocker bearings. Provide all bearings with transverse restraints, and all anchor bolts for bridge bearings with an anchor plate at the embedded end. Provide all abutments with a full-width, continuous-bearing seat, mechanically stabilized wall systems may be used to support abutments only with the prior approval of the state foundation engineer. For abutment and retaining walls, use dowels in addition to normal shrinkage and temperature steel on the compression face to connect the stemwall to footing. Spread footings for abutments and piers must have reinforcement in the top face to resist seismic forces.

d. **Detailing Standards**: For new bridges, special detailing standards are required for the four components of the bridge system: superstructure, bearings and joints, substructure, and foundation. In addition, pay special attention to the following areas:

   - **Special reinforcement for columns:** Per AASHTO, extend reinforcement the required distance into the soffet of the superstructure and into the footing.

   - **Vertical column reinforcement:** Laps shall be within the centermost section of columns.

   - **Footing steel layout (abutments and piers):** We require a minimum reinforcement of #8 bars at 12 inches each way, top and bottom.

1120.3.4 Vertical Clearance

Reference Table 1130-1 for vertical clearances.

1120.3.5 Bridge Rail

The standard bridge rail will be the "Oregon Two-Tube" rail with curb, with PL-2 rating. The concrete barrier or some other crash-tested rail shape may be desirable in some circumstances. Do not use railings other than the Oregon Two-Tube unless approved by the chief bridge engineer. Bridge rail must comply with NCHRP 350 test level 2 or 3.

1120.3.6 Bridge Decks

Make the minimum deck thickness 6 inches, including prestressed units. All reinforcing steel in the deck (for precast girders this would include the stirrups) shall be epoxy-coated. Minimum concrete cover on reinforcing steel in cast-in-place decks shall be 2.5 inches, with a minimum cover on prestressed units of 2.5 inches.

1120.3.7 Bridge Deck Protection

Use a full-width deck membrane on all bridge decks, overlaid with a minimum of 2 inches of asphalt.

1120.3.8 Elastomeric Pads

Elastomeric compound used in the construction of the pads shall contain only virgin natural polyisoprene (natural rubber) as the raw polymer. Do not use Neoprene.

1120.3.9 Shear Transfer on Skewed Bridges

In a skewed bridge, the loads tend to distribute to the supports in a direction normal to the support. This causes a greater portion of the load to be concentrated at the obtuse corners of the span and less at the acute corners. On concrete girders, additional shear reinforcing is required; on steel girders, additional transverse stiffeners may be required, depending on diaphragm type and location.

HORIZONTAL CURVE, GRADE AND SIGHT DISTANCE CRITERIA SUMMARY

Design Speed (mph)	SIGHT DISTANCE (2)		HORIZONTAL CURVES					MAXIMUM GRADES % (1)								
	MINIMUM	MINIMUM	DESIRABLE		MINIMUM*	MAXIMUM	MINIMUM**	FUNCTION and TERRAIN								
	STOPPING (feet)	PASSING (feet)	RADIUS (feet) (4)	DEGREE OF CURVE (4)	RADIUS (feet) (4)	DEGREE OF CURVE (4)	LENGTH (feet) (4)	ARTERIAL			COLLECTOR			LOCAL		
								L	R	M	L	R	M	L	R	M
20	115	710	155	36.75	115	49.25	(3)				7	10	12	8	11	16
25	155	900	235	24.25	185	30.75	(3)				7	10	11	7	11	15
30	200	1090	350	16.25	275	20.75	450				7	9	10	7	10	14
35	250	1280	550	10.25	380	15.00	525				7	9	10	7	10	13
40	305	1470	750	7.50	510	11.00	600	5	6	8	7	8	10	7	10	13
45	360	1625	1250	4.50	660	8.50	675	5	6	7	7	8	10	7	9	12
50	425	1835	1725	3.25	835	6.75	750	4	5	7	6	7	9	6	8	10
55	495	1985	2500	2.25	1065	5.25	825	4	5	6	6	7	9	6	7	10
60	570	2135	3500	1.50	1340	4.25	900	3	4	6	5	6	8	5	6	
65	645	2285	5000	1.00	1660	3.25	975	3	4	5						

* Maximum e ≤ 6%

** The minimum length for horizontal curves on main highways, $L_{C\,min}$ should be about 15 times the design speed in mph. On high speed controlled-access facilities that use flat curvature, a desirable minimum length of curve for aesthetic reasons would be about double the minimum length described above, or $L_{C\,des}$=30V

(1) Short grades (500 ft long or less) and one-way downgrades may be one percent steeper. L = Level, R = Rolling, M = Mountainous. Urban arterial grades except for freeways and expressways may be increased to the maximums indicated for Collectors. Grades may be 2% steeper than shown for low-volume rural highways. The minimum grade for streets with curb and gutter is 0.3%.

(2) Sight distances are based on a drivers height of eye of 3.5 ft, height of object for stopping of 2 ft and height of object for passing 3.5 ft.

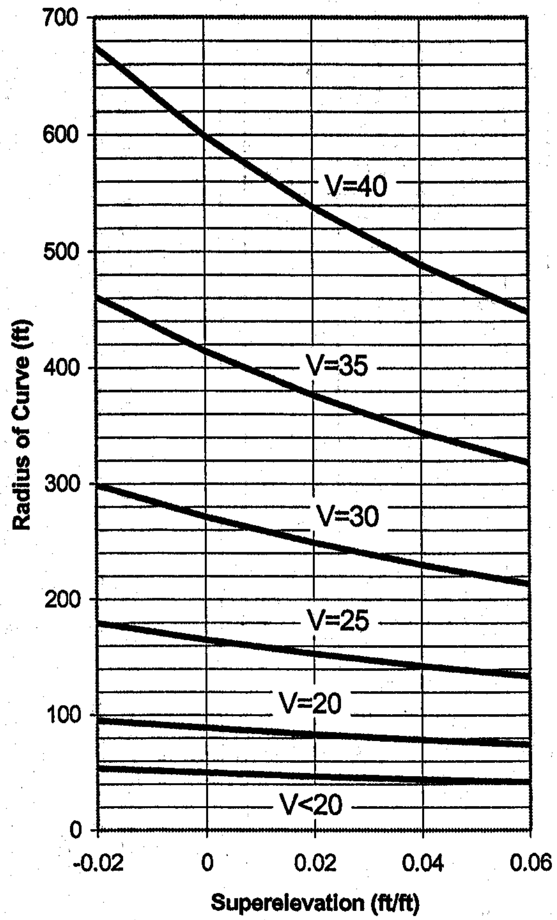
(3) Design speeds of 20 and 25 mph are usually restricted to local roads and separate turning roadways where other design criteria apply.

(4) Radii and degree of curvature are rounded for design and field layout convenience and do not necessarily equate. Only one system (radius or degree of curvature) should be used on a given roadway. This does not preclude use of degree of curvature for through roadways and radii for turning roadways in the same project.

(5) The radius and degree of curve values in this table are for higher speed roadways. Low speed streets may use values presented in Figure 1120-2. Gravel roads should use radius values shown in Figure 1120-3.

Figure 1120-1
Horizontal Curve, Grade, and Sight Distance Criteria Summary

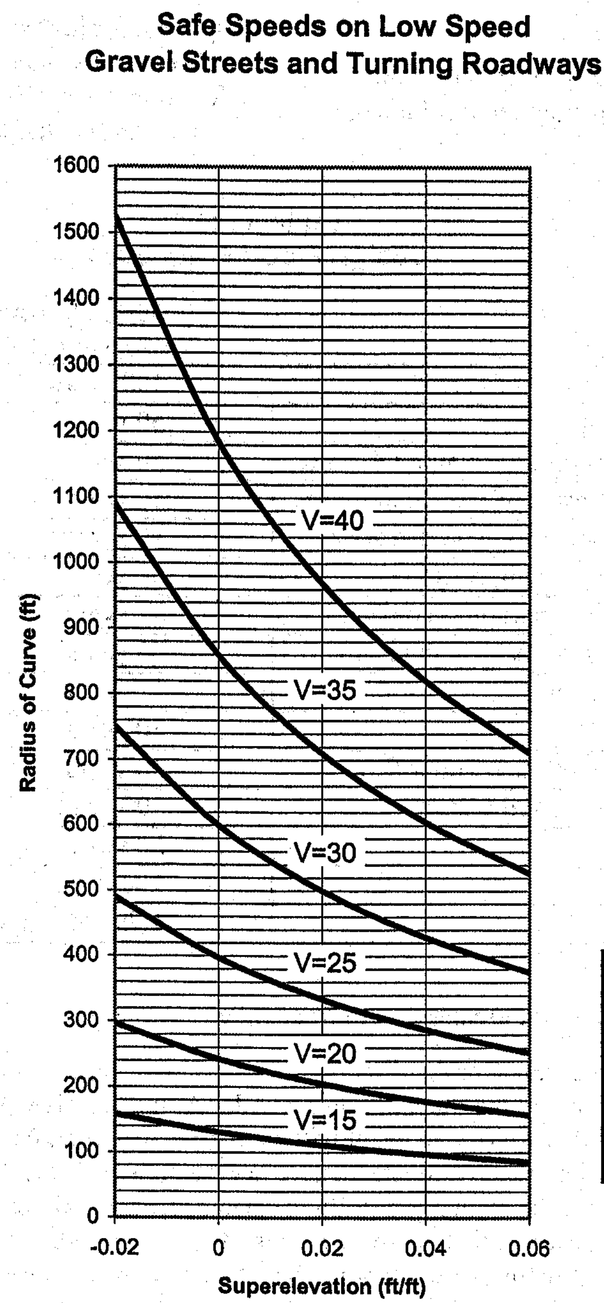
Safe Speeds on Low Speed
Paved Streets and Turning Roadways



V	f
<20	0.300
20	0.300
25	0.252
30	0.221
35	0.197
40	0.178

Motorists navigating low-speed streets and turning roadways expect to encounter higher side-thrust (f) values, hence, the higher "f" values used in the standard formulas. These values may be used in critical locations for urban collector and local streets with design speeds less than 40 mph. See Figure 1120-1 for radii on higher speed roadways with standard superelevation rates.

Figure 1120-2
Design Speeds on Low-Speed Paved Streets and Turning Roadways



V	f
15	0.115
20	0.110
25	0.105
30	0.100
35	0.095
40	0.090

Figure 1120-3
Design Speeds on Low-Speed Gravel Streets and Turning Roadways

1120.4. Drainage

This section sets forth the design criteria for the hydraulic and hydrologic development of drainage systems for highways. When using these policies, follow the hydraulic and hydrologic design methods found in the *Alaska Highway Drainage Manual* and the *AASHTO Highway Drainage Guidelines*.

Table 1120-1
Design Flood Frequency

Type of Structure	Design Frequency Exceedance Probability	
Culverts in designated flood hazard areas*	100 years	(1%)
Culverts on primary highways	50 years	(2%)
Culverts on secondary highways with high DHVs or	50 years	(2%)
Culverts on secondary highways of less importance	10 years	(10%)
Channel changes in designated flood hazard areas	100 years	(1%)
Channel changes along primary highways and	50 years	(2%)
Channel changes along less important secondary	25 years	(4%)
Trunk storm sewers lines on primary highways	50 years	(2%)
All other trunk storm sewer lines	25 years	(4%)
Storm sewer feeder lines	10 years	(10%)
Side ditches, storm water inlets, and gutter flow	10 years	(10%)
Bridges in designated flood hazard areas*	100 years	(1%)
Bridges on all highways	50 years	(2%)
Scour at bridges, design	100 years	(1%)
Scour at bridges, check	1.7x100 years or 500 years	(0.2%)

* Unless local ordinance requires a greater design frequency

Note: In addition to the exceedance probability used for design purposes, the Federal Highway Administration under Executive Order #11988 and the State of Alaska under Administrative Order #46 (AO #46) require the evaluation of a structure's ability to pass an event with an exceedance probability of 1 percent (Q100). This evaluation is required on all tidal and freshwater stream encroachments (i.e. 100-year tidal surge and/or 100-year flood). AO #46 further requires the evaluation of flood-related, erosion-prone, and mud slide (i.e. mud flow) hazard areas. In the case of erosion, this includes currents of water exceeding anticipated cyclical levels, an unusually high water level in a natural body of water accompanied by a severe storm, an unanticipated force of nature, a flash flood or an abnormal tidal surge, or some similarly unusual and unforeseeable event that results in flooding. For mud slides, this includes periods of unusually heavy or sustained rain.

1120.4.1 Cross Drainage Culverts

Design culverts for the appropriate Hw/D Ratio. See Chapter 9 of the *Alaska Highway Drainage Manual* for the Hw/D Ratio for the particular application.

The minimum diameter for round cross-drainage culverts shall be 24 inches (Equivalent pipe-arch culverts shall have a minimum span-to-rise of 29 inches by 18 inches.). However, in icing problem areas, 36-inch diameter, round culvert pipes will be the minimum. We do not recommend equivalent pipe-arch culverts in icing areas.

Evaluate all culverts 48 inches in height or greater for the potential to fail during a design discharge due to hydrostatic and hydrodynamic forces, erosion, saturated soils, or plugging by debris. Any culvert that is found to have a failure potential must be restrained at the ends by half-height concrete headwalls or an equivalent, deadmen, or other form of vertical restraint.

Restrain all mitered pipes with half-height concrete headwalls or an equivalent. Deadmen or other forms of comparable vertical restraint are acceptable if the culvert invert lip is structurally reinforced.

1120.4.2 Storm Sewers

Inlets in sag locations require special attention from the designer and special design criteria are required to size and space them properly (See *Alaska Highway Drainage Manual*). A sag is any portion of the roadway where the profile grade changes from a negative grade to a positive grade. The depression formed is capable of ponding water that extends more than halfway into the nearest traveled lane if all the grate inlets become plugged with debris. This ponded area is generally contained by a curb, traffic barrier, retaining wall, or any other obstruction that prevents it from flowing off the traveled roadway.

A sag vertical curve that is located in a fill section would not be considered a sag in the above sense if the runoff can overtop the curb and flow down the fill slope without ponding water over more than half of the nearest traveled lane. Width of spread criteria for gutter flow can be found in the *Alaska Highway Drainage Manual.*

Avoid placing sags on bridges. It is difficult to fit inlets among the reinforcing steel and the location of downspouts is often limited.

Locate and size the inlets using the procedures outlined in the *Alaska Highway Drainage Manual.*

Provide Inlet Grates: Hydraulic-efficient and bicycle-resistant inlet grates on all storm sewer inlets. The *Alaska Highway Drainage Manual* lists acceptable grates.

1120.4.3 Filter Courses or Subsurface Drainage Matting

All required filter cloth, geotextile filters or fabrics, geomembrane systems, geosynthetic materials, or granular material filter courses must be specifically designed for the application and be called for and/or detailed in the project plans.

1120.4.4 Hydraulic Site Surveys

Coordinate site survey efforts with the state hydraulic engineer for all bridge structures (all hydraulic structures greater than 20 feet in length measured parallel to the roadway centerline, including single and multiple culvert installations), and regional hydraulic engineers for culvert installations and other drainage structures such as stormwater facilities. Site surveys for erosion and sediment control shall be as directed by the regional hydraulic engineer. Early coordination is critical. The hydraulic engineer may be required to visit the site prior to or with the survey crew. Site survey efforts from within consultant contract designs shall be under the direction of the consultant's engineer-in-responsible-charge.

Obtain survey data that will represent the typical conditions at the structure site as well as other locations where stage-discharge and related information will be necessary. The type of hydraulic analysis will govern the density of site data required. The following requirements for hydraulic site surveys are meant to supplement normal topographic survey requirements. Surveys for computerized terrain modeling will require additional site information, such as definition of slope break lines and distribution of survey points with regard to triangular networks (TIN). Cross-sections derived from a TIN by interpolation are not sufficiently accurate for hydraulic modeling purposes.

Site survey requirements for the design of bridges, culverts, and other drainage facilities shall include the following items commensurate with the significance of environmental impact, risk, and importance of the structure:

description of the culvert, including height, width, and condition. Document pertinent observations with a photograph (e.g. inlet, outlet, etc.).

- Survey for horizontal and vertical location other private and public structures that may be affected by the project and/or the hydraulic structure's performance. Document these structures with photographs.

1120.4.5 Hydrologic and Hydraulic Standards

1. **Hydrology:** The hydrologic methods used to determine flood flow frequencies shall conform to the standards prescribed in the *Alaska Department of Transportation and Public Facilities Alaska Highway Drainage Manual.*

2. **Hydraulic:** Hydraulic design standards shall conform to the standards prescribed in the *Alaska Highway Drainage Manual, DOT&PF Standard Specifications for Highway Construction* and the *AASHTO Highway Drainage Guidelines.*

1120.4.6 Hydrologic and Hydraulic Reports

For all bridges and all culverts 48 inches in diameter or greater, a Hydrologic and Hydraulic Report is required (The Hydrologic and Hydraulic Summary can be used as the report for culverts).

The state hydraulic engineer is responsible for the hydrologic and hydraulic design aspects of all bridge projects. Regional hydraulic engineers are responsible for all single and multiple culvert projects of spans less than 20 feet, measured parallel to centerline of roadway, and other drainage projects requiring a report. A qualified hydraulic engineer shall stamp consultant-prepared Hydrologic and Hydraulic Reports after review and approval by the appropriate DOT&PF regional or statewide hydraulic engineer. In addition, all changes or addendum should be reviewed prior to the start of construction. Stamped Hydrologic and Hydraulic Reports shall be forwarded to the design project manager for distribution and will become a permanent part of the project record.

Include in the Hydrologic and Hydraulic Report the following information, commensurate with the significance of the environmental impact, risk, or importance of the crossing:

A. **Location map and site plan**

B. **Description of the project and any alternates**

C. **Hydraulic history of the site**, which should include, but is not limited to, the following:

1. **Tidal:** Tidal influence
   a. Mean Lower Low Water Elevation (MLLW)
   b. Mean High Water Level Elevation (MHW)
   c. Mean Higher High Water Elevation (MHHW)
   d. Extreme High water Elevation (EHW)
2. **Nontidal:** Freshwater streams
   a. Flood of record elevation
   b. High water marks
   c. Ordinary High Water Elevation (OHW) or Meander Line Elevation (ML) if documented
3. **Navigation:**
   a. Present
   b. Future or potential
4. **Confluence:**
   1. Upstream
      - Distance
      - Potential changes
   2. Downstream
      - Distance
      - Potential backwater
5. **Mining Activity:**
   a. Present
   b. Future or potential
6. **Debris Problems:**
   a. Trees and underbrush
   b. Bedload
   c. Mud flow
   d. Debris flow

- Provide a summary of the survey that includes a description of the basis of survey, monuments, local coordinate system with sketch, true north direction, and project datum elevation. Project datum must be reconciled with the as-built information of any existing structures within the project. If the project has tidal considerations, project datum shall be MLLW. Reconcile project stationing with any existing as-built stationing.
- Ordinary High Water Mark (OHW) shall be surveyed for all stream crossings along both banks within the right-of-way limits of the project. The ordinary high water mark (defined by 11AAC53.900[23]) forms a boundary line along the bank or shore up to which the presence and action of nontidal water are so common and usual, and so long continued in all ordinary years, as to leave a natural line impressed on the bank or shore and indicated by erosion, shelving, changes in soil characteristics, destruction of terrestrial vegetation, or other distinctive characteristics. The OHW line forms a jurisdictional boundary and is determined by a land surveyor registered in Alaska. Similarly, survey the High Tide Line tidal areas. Include time and date tags in water level measurements, and document the edge of water along both banks at the time of survey. If extreme high water marks are evident, locate and survey them at various points along the stream to help define the hydraulic grade line of the high water.
- For bridge sites, stream cross sections normal to flow direction that define the floodplain, banks, and channel bottom shall be surveyed at intervals upstream and downstream from the hydraulic structure. Generally, these cross sections will be spaced approximately one channel width. A minimum of four cross sections downstream of the structure and three cross sections upstream of the structure are usually required. Hydraulic modeling considerations require one cross section each at the downstream and upstream edges of the deck. If the bridge is skewed with respect to the flow, these two cross sections should be placed at the downstream and upstream corners respectively. Each cross section should be long enough to encompass the limits of the floodplain and have surveyed points (x, y, z) at each slope breakpoint. In addition to cross sections, both edges of water and tops of banks shall be surveyed at the midpoint between each cross section or every 50 feet, whichever is less. Additional shots may be required to supplement cross section information at sharp bends in streams. For shallow streams, wading will be required. For deeper rivers, hydrographic (boat) survey will be required. Document pertinent observations with photographs.
- If the site involves an existing bridge, locate the structure horizontally and vertically with stations, offsets, and elevations. Bearings for tangents to the bridge shall be provided and compared to as-built information. Reconcile new surveys with as-built information, and elevation and station conversion equations supplied. Survey existing centerline profile on the structure and for a minimum of 200 feet from either end of the bridge. Normally required points to be surveyed on the bridge include Begin Bridge, End Bridge, centerline of pier(s), and the four corners of the structure. If asphalt is present, contact Bridge Design Section for preferred alternative point locations. Shots made on the bridge structure should be specific points that are thoroughly described so they are identifiable and repeatable. Survey existing embankment approaches to the bridge. A sufficient number of survey points under the structure to define embankments and stream banks in those areas are usually required.
- For culvert sites, cross sections normal to direction of flow that define the floodplain, banks, and channel bottom shall be surveyed at intervals upstream and downstream from the hydraulic structure. Survey cross sections at the estimated upstream and downstream embankment catch points. As a typical minimum, survey two additional cross sections upstream and downstream at intervals of approximately one stream width or 20 feet, whichever is greater. Survey the thalweg line (the line of deepest channel) at a maximum of a point every 20 feet between each cross section. Survey the inverts and station/offsets for both ends of existing culverts, and record a

e. Lake dumps

7. **Icing Problems:**

   a. Types of Icing Problems

      - Frazil
      - Glaciering
      - Ice debris
      - Glacier-dammed lakes (type of breakout)

   b. Location

      1. At bridge
         - Thickness
         - Elevation
         - Unusual loads on existing piers
         - Scouring of existing piers
      2. Upstream
      3. Downstream

   c. Flow over ice

   d. Flow under ice

   e. Type of breakup

8. **Geomorphology:**

   a. Straight

   b. Meandering

   c. Braided

   d. Alluvial fan

   e. Aggradation

   f. Degradation

   g. Potential for lateral movement

9. **Bedload:** Bed material size

10. **Environmental:** Environmental activities, such as fish passage considerations, that relate to the hydraulics of the stream or installation

D. **Hydrology:** A discussion of the hydrology of the site should include, but is not limited to, the following:

1. **Drainage Shed:** Contributing drainage area at the site

   a. Storage area

   b. Stream slope

   c. Mean elevation

   d. Area of glaciers

2. **Geometry:** Limiting factors

   a. Road sag elevation

   b. Backwater constraints

   c. Private property

   d. Access requirements

3. **Frequency:** Perform a flood frequency analysis for all bridges, longitudinal encroachments or culverts 48 inches in diameter and larger (or equivalent for other shapes) as follows:

   a. Q50: 2 percent probability

   b. Q100: 1 percent probability

      - Or capacity of structure if less than Q100
      - If the capacity is less than Q100, address the probable damage, environmental impact, and economic costs that will result.
      - Culverts on secondary highways of less importance (See Table 1120-1, Design Flood Frequency) may be designed for a 10-year flood capacity. However, evaluate the culvert for overtopping at the 50- and 100-year flood.

   c. Probability, or capacity of structure if less than Q200

   d. Q500: 0.2 percent probability, or capacity of structure if less than Q500

   e. Overtopping flood

      - Approximate exceedance probability
      - Water surface elevation

- Location (where determined)

f. Other high water events as required

When data are sparse, or may lack the desired level of credibility, address the limitations of the analysis, probable error, or risk factor.

4. **Fish Passage:** In addition to item 3 above, evaluate proposed culverts in streams that support anadromous fish (i.e. salmon, grayling, etc.) for fish passage capabilities during an event that has an exceedance probability of 50 percent with a potential of a two-day delay (Q2-2).

5. **Peak Discharge:** The design frequency (Q10, Q50, etc.) versus the peak discharge (Flood of Record) relationship for the site

E. **Local input:** Local knowledge of past floods at the site

F. **Backwater:** A backwater analysis of the existing structure (or natural channel) versus the proposed structure(s) during a high water event that has an exceedance probability equal to 1 percent (Q100)

G. **Scour:** For bridges, the calculated general, pier, and abutment scour associated with the proposed structure(s) and any counter-measures required for the following exceedance probabilities:

1. Q100: 1 percent probability
2. Q500: 0.2 percent probability, or the capacity of the structure if less than Q500
3. Additional: Evaluate the structure for scour for lesser recurrence intervals as required, or as engineering judgment dictates. If you incorporate appropriate abutment scour protection into the design, abutment scour calculations are not required.

H. **Hydraulic Design:** A discussion of the hydraulic features of the design and why they are needed

1. Alternate designs and their features
2. A discussion of the limitations of the alternates and why they were rejected

I. **23 CFR:** The 23 Code of Federal Regulations (23 CFR), part 650.111, "Location Hydraulic Studies," requires the following items be addressed for all construction projects that encroach on the 100-year floodplain:

1. Use National Flood Insurance Program (NFIP) maps or information developed by the highway agency, if NFIP maps are not available, to determine whether a highway location alternative will include an encroachment.
2. Include in location studies an evaluation and discussion of the practicability of alternatives to any longitudinal encroachment.
3. Also include in location studies a discussion of the following items, commensurate with the significance of the risk or environmental impact, for all alternatives containing encroachments and for those actions that would support base floodplain development:

    a. The risks associated with the implementation of the action

    b. The impacts on natural and beneficial floodplain values

    c. The support of probable incompatible floodplain development

    d. The measures to minimize floodplain impacts associated with the action

    e. The measures to restore and preserve the natural and beneficial floodplain values affected by the action

4. Include in location studies an evaluation and discussion of the practicability of alternatives to any significant encroachments or any support of incompatible floodplain development.
5. The studies required by part 650.111, 3 and 4 above shall be summarized in the environmental review documents prepared pursuant to 23 CFR, Part 771.
6. Consult local, state, and federal water resource and floodplain management agencies to determine if the proposed highway action is consistent with the existing watershed and floodplain management programs and to obtain current information on development and proposed actions in the affected watersheds.

J. **Conclusion:** A summary of the hydraulic features

3. Longitudinal: Top of riprap or top of structure elevation

G. **Datum Elevation:** Datum and equation for Mean Sea Level (MSL) to Mean Lower Low Water (MLLW) if appropriate

H. **Design Streambed Elevation:** The elevation of the stream bed (or average stream bed) in feet, used for design purposes

I. **Scour:** The calculated Contraction (general) Scour depth and Local Scour depths at the piers and abutments for all bridges for the following exceedance probabilities:

   1. 1 percent exceedance probability (Q100)
   2. 0.2 percent exceedance probability (Q500)*
   3. Capacity of bridge if less than a Q500
   4. Crossings of greater importance shall be analyzed for other exceedance probabilities as required.

* Including regulatory flood in designated flood hazard areas (if available).

and how they will accomplish the desired protection

K. **Rip rap:** The size of rip rap required, the method of placement, and depth of key or length of toe

L. **Flood Hazard Area:** If the proposed project falls within a designated flood hazard area, the following is required:

  1. Additional Requirements: A discussion on the additional requirements imposed on the design because of the local floodplain regulations
  2. Compliance: The proposed methods of complying with the regulations
  3. Certification: Statement of certification as required by local ordinance

M. **Illustrations:** Include clarifying drawings, tables, charts, graphs, or pictures where appropriate.

N. **Documentation:** Include supporting or pertinent documentation in the appendices.

O. **Certification:** A registered professional engineer will stamp all hydraulic reports.

1120.4.7 Summary Hydraulic Report

A Summary Hydraulic Report may be used for projects that have minor hydraulic impact or risks such as smaller bridges, projects with culverts only, or minor longitudinal encroachments. Consultant-prepared reports may use a Summary Hydraulic Report after consultation with the appropriate regional or statewide hydraulic engineer. Requirements for review, stamping, and submittal are the same as those stated in Section 1120.4.6. Projects that have major bridge crossings or are in designated flood hazard areas shall have a full hydraulic report. A Summary Hydraulic Report shall consist of the following as a minimum:

1. Introduction
2. History
3. Hydrology
4. Hydraulic Design
5. 23 CFR
6. Conclusion
7. Rip rap

1120.4.8 Hydrologic and Hydraulic Summary

Include a Hydrologic and Hydraulic Summary on all plan sheets that have hydraulic encroachments as follows:

A. The site plan sheet for all bridges

B. The plan sheet for longitudinal encroachments. If the encroachment is depicted on more than one plan sheet, place the summary on the first sheet where the encroachment begins.

C. The plan sheet for culverts as follows:

  1. All culverts 48 inches in height or greater
  2. Any multiple culvert installation that has a total high water flow of 500 cubic feet per second (cfs) or greater for an exceedance probability of 2 percent (Q50)
  3. All culverts smaller than 48 inches in height for which a hydraulic analysis has been performed

Include in the Hydrologic and Hydraulic Summary the following information:

A. **Drainage Area** in square miles

B. **Exceedance Probabilities:** The exceedance probabilities in percentages used to size the installation as required by Table 1120-1, Design Flood Frequency

C. **Design Discharges*** in cubic feet per second (cfs) for the exceedance probabilities required in above section (Table 1120-1, Section D3)

D. **Design High Water Elevation*** in feet for the exceedance probabilities required in item I above

E. **Anticipated Additional Backwater:** For highway crossings the additional backwater in feet for a high water event having an exceedance probability of 1 percent (Q100)

F. **Overtopping Flood:** For highway crossings, the discharge in cfs and water surface elevation in feet of the overtopping flood and its exceedance probability. The overtopping elevation is defined as follows:

  1. Bridges: low steel (chord) or low-grade elevation
  2. Culverts: Low-grade elevation

Summary Example
Hydrologic and Hydraulic Summary

Drainage Area	25 square miles		
Exceedance Probability	2%	1%	*Regulatory Flood
Return Period	50-year (Q_{50})	100-year (Q_{100})	
Design Discharge	1,500 cfs	1,750 cfs	2,500 cfs
Design High Water Elevation	961.0 ft	961.9 ft	964.0 ft
Anticipated Additional Backwater = 0.2 ft			

The capacity of the structure is 2,500 cfs at elevation 964.0 feet, which has an exceedance probability equal to or less than 0.2 percent (Q500).

Datum = Mean Lower Low Water (-7.6 feet)

The following scour information shall be provided on bridge plans only:

Scour from streambed elevation 85 feet:

Return Period	100-year (Q_{100})	500-year (Q_{500})
Contraction Scour	1.0 ft	2.0 ft
Abutment Scour	9.0 ft	10.0 ft
Pier Scour	3.0 ft	4.0 ft

* Shall be provided for the regulatory flood in designated flood hazard areas, if available.

1120.5. Turnouts

1120.5.1 Types

- **Truck Emergency Turnout:** This is a widened shoulder area that is used at locations where frequent truck stops are anticipated or experienced. Typically these turnouts are provided at the beginning of passes to install tire chains or at the top of steep grades to check brakes.

- **Slow Vehicle Turnout:** A widened shoulder area provided for slow moving vehicles to pull over without stopping to allow a queue to pass. Generally, two-lane highways with substantial recreational vehicle traffic and limited passing opportunities can benefit from these turnouts.

- **Scenic Turnout:** This is a widened shoulder area or a separated turnout for the motorist to stop to view a point of interest. Anticipated stays are short and rest facilities generally are not provided.

- **Rest Area:** This is a separated turnout to provide breaks for motorists. Convenience and comfort facilities may be provided.

1120.5.2 References

Figures 1120-4 through 1120-7 are examples of minimum recommended scenic turnouts and rest areas. Geometric, geomorphic, and environmental conditions generally dictate a custom design. References available for rest area design are provided below:

- *A Guide for Development of Rest Areas on Major Arterials and Freeways*, AASHTO, 2001, *A Guide for Transportation Landscape and Environmental Design*, AASHTO, 1991

- FHWA-IP81-1, *Safety Rest Areas: Planning, Location and Design*, FHWA, 1981

- FHPM 6-2-5-1 *Landscape and Roadside Development*

- RD-77-07 *Waste Water Treatment Systems for Safety Rest Areas*, FHWA, 1977

1120.5.3 Accessibility

Scenic turnouts and rest areas and any included facilities must be accessible in accord with the Americans with Disabilities Act.

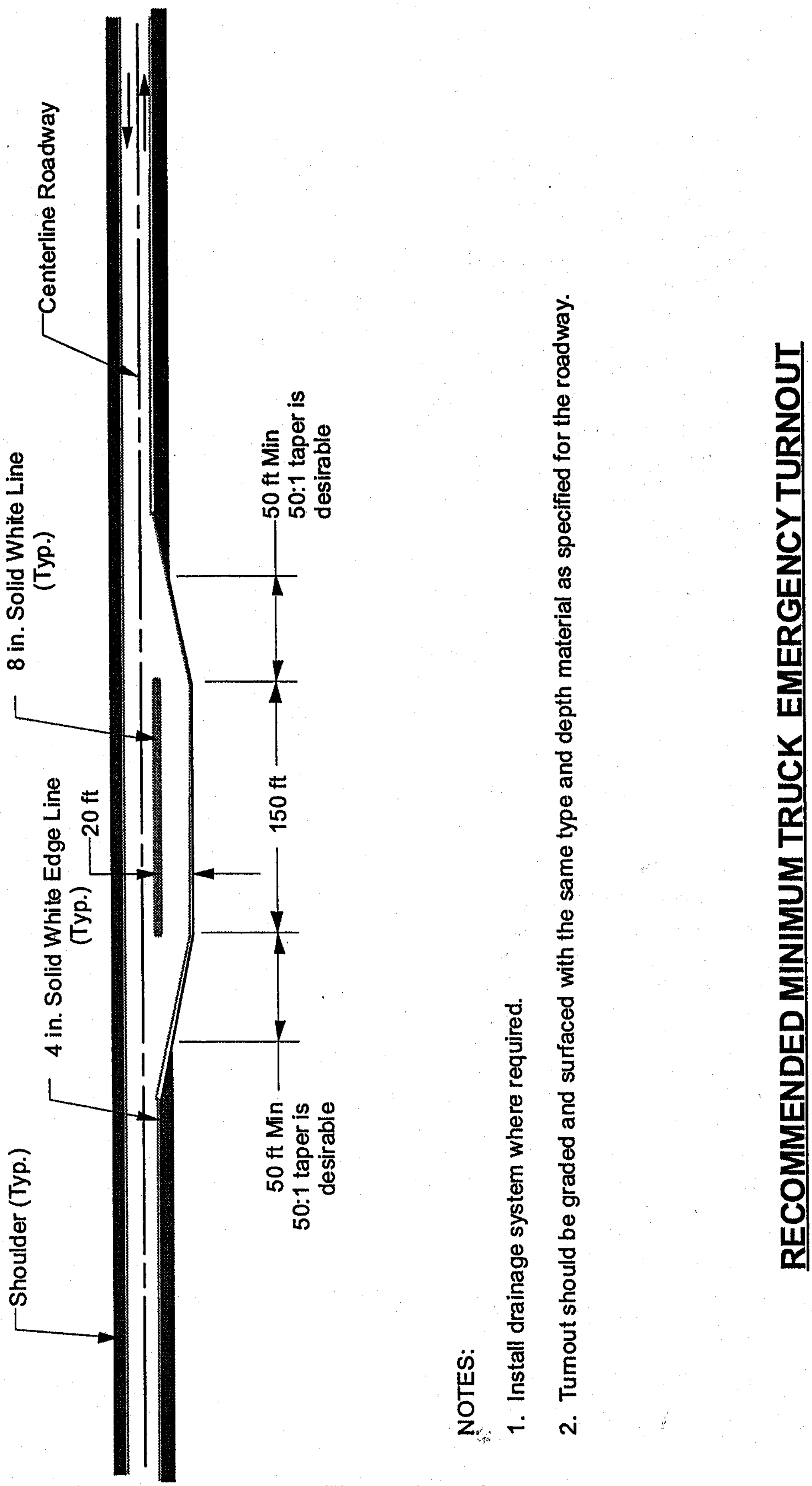
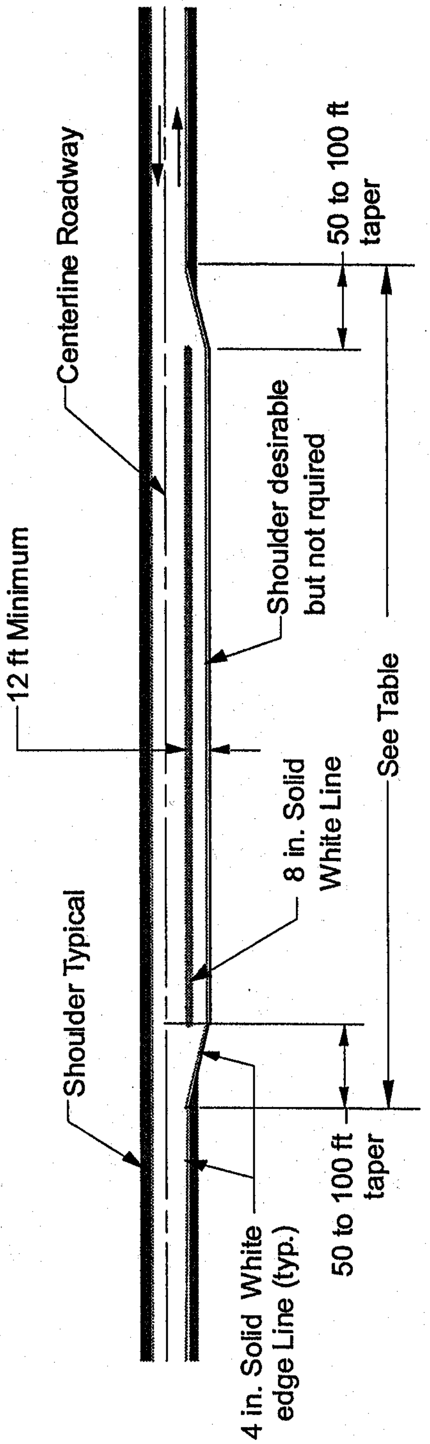


Figure 1120-4
Recommended Minimum Truck Emergency Turnout



APPROACH SPEED (mph) OF SLOW VEHICLE	MINIMUM LENGTH (ft) *
25	200
30	200
40	300
45	350
50	450
55	550
60	600

* Maximum Length should be 600 ft to avoid use as passing lane.

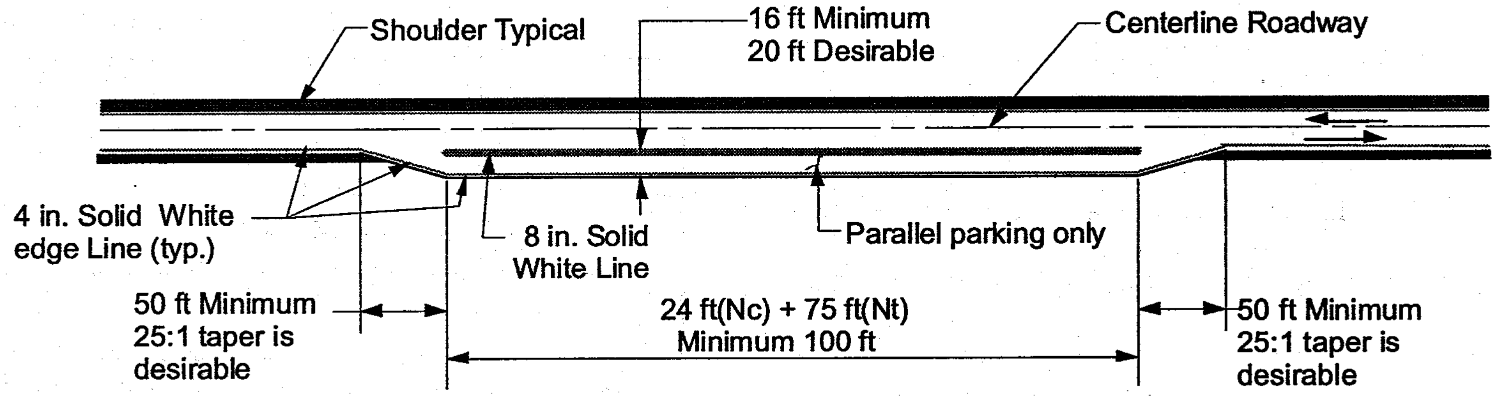
SIGNS

See Alaska Sign Design Manual for applicable signs.

See the Alaska Traffic Manual for sign placement.

SLOW VEHICLE TURNOUT FOR RURAL TWO LANE ROADWAYS

Figure 1120-5
Slow Vehicle Turnout for Rural Two-Lane Roadways



RECOMMENDED MINIMUM SCENIC VIEW POINT

PARKING

Car parking space = 24 ft x 8 ft
Truck parking space = 75 ft x 8 ft
Nc = Car parking spaces required
Nt = Truck parking spaces required
ADT = Average daily traffic with access to scenic view point
Dc = percent of traffic composed of cars
Dt = percent of traffic composed of trucks or large RV's
P = Total percent on mainline traffic stopping at rest area adjusted by the ratio DSL/50
DSL = Design section length or distance between turnouts in miles.
Interstate P = 0.12(DSL)/50 Primary (recreational) P= 0.08(DSL)/50 Primary (rural) P = 0.055(DSL)50

Nc = 0.09(ADT)(P)(Dc)
Nt = 0.09(ADT)(P)(Dt)
Source: Minnesota DOT Road Design Manual (rest areas)

SIGNING

Specifications: MUTCD/Alaska Supplement and the Alaska Sign Design Specifications

Ref: AASHTO Guide for Transportation Landscape and Environmental Design 1991
AASHTO 1990 Policy on Geometric Design of Highways and Streets
Transportation and Land Development by Institute of Transportation Engineers

Figure 1120-6
Recommended Minimum Scenic Viewpoint

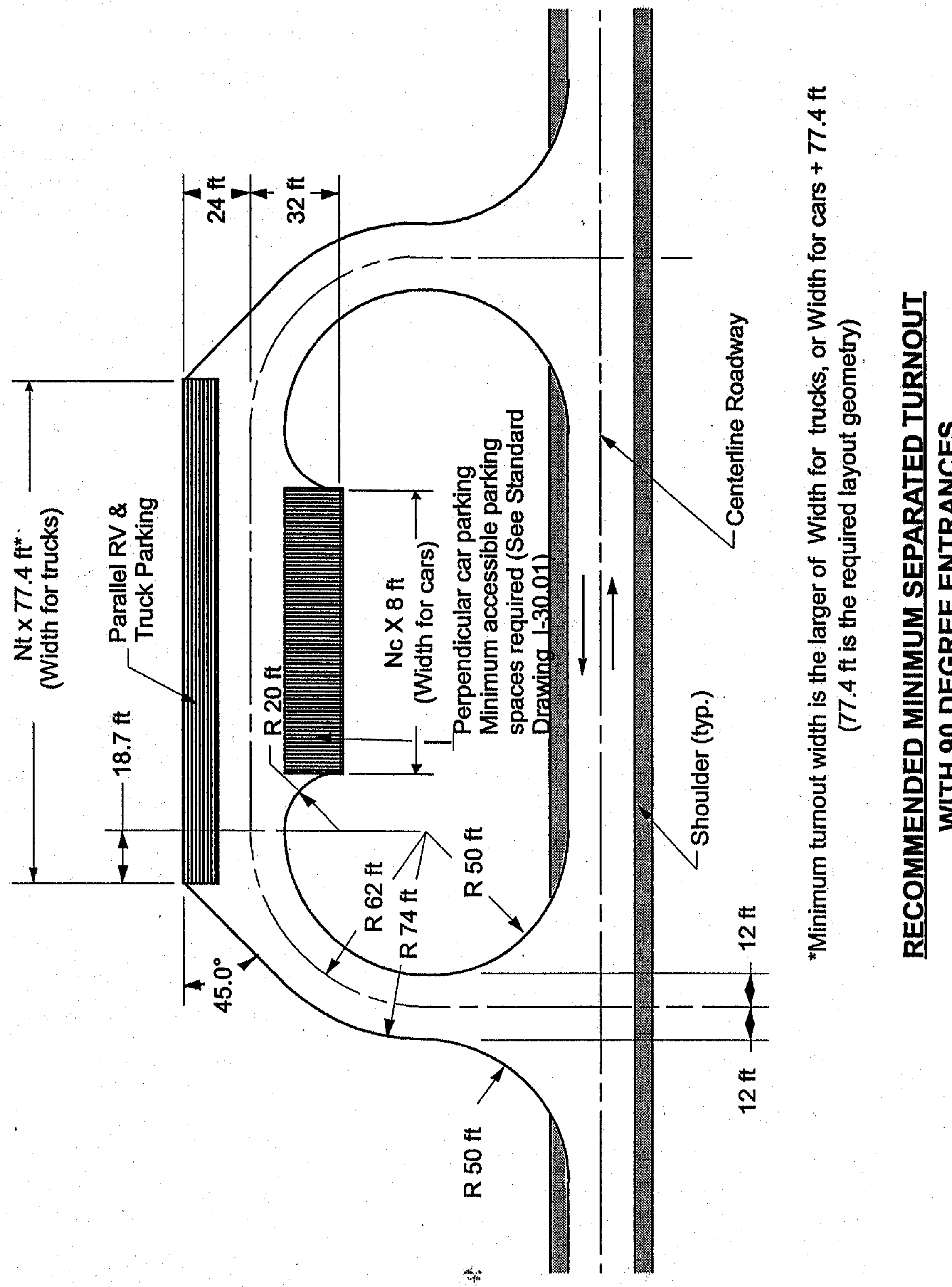


Figure 1120-7
Recommended Minimum Separated Turnout With 90-Degree Entrances

1120.6. Erosion & Sediment Control Plans (ESCP)

Develop an ESCP for all projects with disturbed ground that meet either of the following conditions:

- Owned by the Department
- Designed (or design administered by) and constructed (or construction administered) by the Department

Projects not owned by the Department (such as utilities projects constructed separately from, but in consort with, a Department project) do not require Department involvement in development of an ESCP.

The ESCP for simple projects, such as signal projects or overlays, may be shown directly on the plan and profile sheets. Develop more complex ESCPs on separate "site map" plan sheets.

Use Chapter 16 of the *Alaska Highway Drainage Manual* as a reference for design of erosion and sediment control structures. The *AASHTO Highway Drainage Guidelines* provide additional guidance.

Provide written descriptions or narratives whenever needed to clarify the ESCP.

Include the following items in the ESCP for projects with disturbed ground of 1 acre or more.

- A description of the nature and extent of the construction activity
- A general area location map and a site map
- The total area of the project in acres (to the nearest quarter acre). Include the area within the right-of-way and any known off-site disturbed areas supplied as materials sources, stockpile sites, etc. List the on-site and off-site areas of the project separately.
- Location of disturbed areas. Include areas of excavation, grubbing, embankment, waste, borrow/quarry sites (when known), stockpile sites (when known), etc.
- The area of disturbed ground in acres (to the nearest quarter acre). Include excavated areas, embankments, etc. Do not include the area of pavement removal or overlay if the work does not remove the aggregate underlying the pavement. List on-site and off-site disturbed areas separately.
- Drainage patterns
- Slopes (both naturally occurring and constructed) anticipated after completion of grading activities. You may show slopes by contours, typical sections, or notation on the site map.
- The location of all known temporary and permanent erosion and sediment control measures to be included in the project. Include existing vegetation to be used in control of erosion and sediment. Provide an indication of temporary erosion and sediment control measures that may require installation, relocation and/or removal during construction. Use symbols presented in Chapter 16 of the *Alaska Highway Drainage Manual* to identify erosion and sediment control measures on the ESCP.
- The location and known names of surface waters
- The location and names of any wetlands or wetlands that may be used for controlling erosion and sedimentation (provided by the regional environmental coordinator)
- The location of any impaired waters (provided by the regional environmental coordinator)
- The location of any waters with approved and final Total Maximum Daily Loads (TMDLs) for Alaska (provided by the regional environmental coordinator)
- Locations where storm water is discharged to a surface water
- Listed threatened or endangered species, or their critical habitat, found in proximity to the project (provided by the regional environmental coordinator)
- Information on historic or archaeological sites, including (1) whether any sites listed on the National Register of Historic Places may be affected by storm water discharges, and (2) whether any written agreement is in place

with the state historic preservation officer (provided by the regional environmental coordinator)